AMENDED SPECIFICATION.

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[*The Amendments are shown in erased and italic type.*]

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PROVISIONAL SPECIFICATION.

Improvements in and relating to Preserving Beer.

I, Johann Franz Hugo Gronwald, of 32, Schönhauser Allee, Berlin, in the Empire of Germany, Chemist, do hereby declare the nature of this invention to be as follows:—

This invention relates to a process for rendering beer capable of being kept whilst at the same time avoiding undesirable alterations in the flavour, and is based on the following observations and experiments.

If beer, more particularly fresh or not sufficiently purely fermented beer, or under-fermented (fermented from below) or over-fermented (fermented from the surface) beer, be tested as regards taste and smell, it shows itself more or less impure according to the kind of beer. The reason of this appearance is that peculiar volatile bye-products formed during the fermentation are given off by the beer. If such beer be warmed for the purpose of pasteurizing or sterilizing it, these fermentation products make their presence known by producing in any case under the action of the air remaining in the beer such tastes and smells as characterize beers pasteurized according to the methods hitherto employed.

The applicant has firmly established this by experiments, and has found that this well known alteration of beer during or after pasteurization or sterilization does not take place if, before the treating of the beer, these bye-products formed during the fermentation together with the remaining air be removed from the beer, and this is preferably done before the beer is pasteurized or sterilized by purifying it by mechanical means either in vacuum by drawing off the volatile constitutents and then scrubbing with an indifferent gas, preferably carbonic acid, or by direct repeated scrubbing with the same preferably after a preliminary warming of the beer. The beer thus treated showed, under these experiments, according to the repetition of these operations, an almost completely pure taste and smell and could be subjected to the pasteurizing without the undesired alterations of taste and smell taking place.

On the basis of the experiments effected it is therefore according to the present invention preferable to expose the beer which is to be pasteurized to the action of a greater or lesser vacuum and to draw off the volatile constituents thereby released preferably by means of a pump or by the assistance of an indifferent gas (preferably carbonic acid) conveyed thereto. It is self-evidently immaterial

for the purpose of the invention in what manner the vacuum is produced, for instance whether by means of an air pump or air condenser or the like. If desirable the beer which has been exposed to the vacuum may then be subjected to cold or be heated to about 20—30° C. under pressure and scrubbed with carbonic acid and then only may a heating and cooling in the presence of carbonic acid take place.

If it be not desired to employ vacuum, the removal of the deleterious bye-products and remaining air may take place by repeated scrubbing with carbonic acid under pressure, whilst a heating of the beer to about 20—30° C. may preferably take place.

In the use of vacuum a scrubbing with an indifferent gas or rather carbonic acid after the vacuum treatment and before the pasteurization is not always to be employed but only when it is certain that the treatment under vacuum has been carried out until the volatile bye-products of the beer and any remaining air still present therein have been actually completely removed.

As regards the treatment of the beer under vacuum, experiments have shown that this treatment has not to take place at an increased temperature because when the beer is warmed during the formation of a partial or entire vacuum the aroma of the beer, more particularly of the hops and alcohol, is lost.

The mechanical removal of the volatile bye-products of the beer and of any remaining air existing therein would therefore appear to be the more advantageous, more particularly when working on a large scale in a separate vessel. In this case it is possible to easily carry on the operation continuously; but where it is a question of time and continuous working is not necessary, this mechanical removal of the volatile bye-products both by means of vacuum and also by repeated scrubbing with an indifferent gas (preferably carbonic acid) may take place in the pasteurizing vessel itself.

The practical carrying out of the present invention will be now more particularly described.

In the use of a separate purifying vessel utilizing vacuum, the beer which is to be treated is first conveyed by means of a pipe and rose into a suitable vessel. This vessel which is in communication with a vacuum producing apparatus such for instance as an air pump by means of a pipe and which is provided with an inlet pipe for an indifferent gas for instance carbonic acid, has first a vacuum produced in it which is maintained as far as possible during the operation. By this means the volatile ferment constituents which are deleterious to taste and smell and any remaining air contained in the beer are removed therefrom. As soon as the vessel has been sufficiently filled with such beer, the said beer is forced over into the pasteurizing vessel connected with the purifying vessel by means of a pipe which may be closed by means of a valve, the said forcing over being produced either by means of carbonic acid which is conveyed into the vessel through the inlet pipe or by means of a pump. The pasteurizing vessel is of course first deprived of air and preferably filled with carbonic acid. In order to assist the action of the vacuum, the purifying vessel may be provided with a suitable stirring apparatus or agitator. After this vacuum treatment the beer may if desired be either first scrubbed with carbonic acid under pressure in the vacuum or purifying vessel or only in the pasteurizing vessel. The beer is then either directly after the vacuum treatment or after the subsequent scrubbing just mentioned has taken place, heated and cooled in the pastuerizing vessel in the presence of and in contact with carbonic acid, as will now be more particularly described and is then filled into the transport vessels or barrels.

If it be desired to effect the mechanical removal of the volatile bye-products or the remaining air from the beer without vacuum, gradually by means of a suitable scrubbing of the beer with an indifferent gas (more particularly carbonic acid), this may be effected in a separate vessel, the beer being then driven over into the pasteurizing vessel as was the case with the vacuum vessel, or the beer

may be subjected to treatment in the pasteurizing vessel (heating vessel) itself.

The process may be more particularly described as regards the latter method of working. The pasteurizing boiler or vessel is filled with beer up to about four-fifths of its capacity. The mixture of air and carbonic acid contained above the beer is compressed by means of carbonic acid conveyed therein, and then, after the closing of the vessel, any carbonic acid existing in the same is forced into the beer by means of a stirring apparatus. For this object the boiler is provided with a discharge pipe capable of being closed and also with a carbonic acid supply pipe capable of being closed. It is also provided with a shaft on which the stirrers or arms are mounted. The carbonic acid forced into the beer thus takes the place of the volatile bye-products contained in the beer (air, other gases and volatile compounds) which accumulate in the upper part of the vessel together with such parts of the carbonic acid as again escape from the beer. For the purpose of more rapidly separating the bye-products the beer may be heated to about 30° C. The bye-products accumulated in the upper part of the boiler, in addition to the unabsorbed carbonic acid, may be removed by a blow-off pipe by means of a fresh current of pure carbonic acid. By a frequent repetition of this scrubbing and expelling and letting-off of the carbonic acid at a suitable temperature of about 20—30° C., a thorough removal of the deleterious volatile bye-products and remaining air from the beer may be effected so completely that the heating (pasteurizing) of the beer may then take place.

The following apparatus is suitable for this purpose. The heating boiler is preferably provided with a shaft running right through and having stirrer arms mounted thereon, by the action of which the heating of the beer is rendered even whilst the carbonic acid admitted or introduced into the heating boiler by means of a pipe may be thoroughly combined with the beer. The heating of the beer preferably takes place by means of expanded steam which is conveyed to a heating casing or jacket through a pipe. In order to increase the heating surface, tubes are provided in the interior of the boiler which communicate with the heating casing or jacket. Cooling liquids may be admitted through a pipe on the casing or jacket and steam may if desired be admitted to the boiler through another pipe. The beer is admitted into the heating boiler through a pipe capable of being closed by means of a valve and after treatment may be withdrawn through a valve and pipe. In order to control the temperature thermometers are employed, and safety valves are fitted on the casing or jacket and on the heating boiler itself. Inspection windows or peepholes are also provided to enable the interior of the heating boiler to be inspected. On the under part of the heating casing a pipe fitted with a valve is provided for carrying off the water of condensation and in the lower part of the heating boiler another pipe for cleaning and discharging purposes is similarly arranged.

A discharge pipe is arranged for carrying off the air containing the carbonic acid expelled from the beer, and a pipe for connecting, if desired, with a vacuum apparatus in case it is preferred to support this repeated scrubbing by the use of vacuum.

The subsidiary apparatus such as filters, collecting vats and the like which communicate with the heating boiler by means of pipes capable of being shut off need not further be described, but if desired they may like the heating boiler be made to work with vacuum.

As already stated the removal of the undesirable volatile bye-products of the beer and the remaining air may be effected by the combined use of vacuum and scrubbing. This combined use may be carried out by the vacuum treatment being effected in a separate vessel and the subsequent scrubbing either in the same vessel or in the heating vessel. This combined use of vacuum and scrubbing may however take place in the heating vessel itself. In this case the heating (pasteurizing) of the beer is effected in an hermetically closed vessel and under constant agitation of the beer with carbonic acid until the sterilization is sufficient after which a rapid cooling is effected. All this takes place constantly

in a carbonic acid atmosphere and under pressure whereby any re-infection of the beer is avoided and a re-saturation of the beer with carbonic acid is attained.

If it be desired to produce beer rich in carbonic acid this may be attained by introducing an increased quantity of carbonic acid and by more strongly impregnating the beer with it.

Dated this 12th day of November 1897.

WM. P. THOMPSON & Co.,
Of 6, Lord Street, Liverpool, Agents for the Applicant.

COMPLETE SPECIFICATION (AMENDED).

Improvements in and relating to Preserving Beer.

I, JOHANN FRANZ HUGO GRONWALD, of 32, Schönhauser Allee, Berlin, in the Empire of Germany, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a process for rendering beer capable of being kept whilst at the same time avoiding undesirable alterations in the flavour, and is based on the following observations and experiments.

If beer, more particularly fresh or not sufficiently purely fermented beer, or under-fermented (fermented from below) or over-fermented (fermented from the surface) beer be tested as regards taste and smell, it shows itself more or less impure according to the kind of beer. The reason of this appearance is that peculiar volatile bye-products formed during the fermentation are given off by the beer. If such beer be warmed for the purpose of pasteurizing or sterilizing it, these fermentation products make their presence known by producing in any case under the action of the air remaining in the beer such tastes and smells as characterize beers pasteurized according to the methods hitherto employed.

The applicant has firmly established this by experiments, and has found that this well known alteration of beer during or after pasteurization or sterilization does not take place if, before the heating of the beer, these bye-products formed during the fermentation together with the remaining air be removed from the beer, and this is preferably done before the beer is pasteurized or sterilized by purifying it by mechanical means either in vacuum by drawing off the volatile constituents and then scrubbing with an indifferent gas, preferably carbonic acid, or by direct repeated scrubbing with the same preferably after a preliminary warming of the beer for the said scrubbing. The beer thus treated showed, under these experiments, according to the repetition of these operations, an almost completely pure taste and smell and could be subjected to the pasteurizing without the undesired alterations of taste and smell taking place.

On the basis of the experiments effected it is therefore according to the present invention preferable to expose the beer which is to be pasteurized to the action of a greater or less vacuum and to draw off the volatile constituents thereby released preferably by means of a pump or by the assistance of an indifferent gas (preferably carbonic acid) conveyed thereto. It is self-evidently immaterial for the purpose of the invention in what manner the vacuum is produced, for instance whether by means of an air pump or the condensation of steam or the like. If desirable the beer which has been exposed to the vacuum may then be subjected to cold or be heated to about 20—30° C under pressure and scrubbed with carbonic acid and then only may a heating and cooling in the presence of carbonic acid take place.

If it be not desired to employ vacuum, the removal of the deleterious bye-products and remaining air may take place by repeated scrubbing with carbonic acid under pressure, whilst a heating of the beer to about 20—30° C may preferably take place.

In the use of vacuum a scrubbing with an indifferent gas or rather carbonic acid after the vacuum treatment and before the pasteurization is not always to be employed but only when it is certain that the treatment under vacuum has been carried out until the volatile bye-products of the beer and any remaining air still present therein have been actually completely removed.

As regards the treatment of the beer under vacuum, experiments have shown that this treatment has not to take place at an increased temperature because when the beer is warmed during the formation of a partial or entire vacuum the aroma of the beer, more particularly of the hops and alcohol, is lost.

The mechanical removal of the volatile bye-products of the beer and of any remaining air existing therein would therefore appear to be the more advantageous, more particularly when working on a large scale in a separate vessel. In this case it is possible to easily carry on the operation continuously; but where it is a question of time and continuous working is not necessary, this mechanical removal of the volatile bye-products both by means of vacuum and also by repeated scrubbing with an indifferent gas (preferably carbonic acid) may take place in the pasteurizing vessel itself.

The practical carrying out of the present invention will be now more particularly described reference being made to the accompanying drawings in which—

Figure 1 is a vertical section of a purifying vessel; Figure 2 is a horizontal section of the pasteurizing vessel, and Figure 3 a cross section of same.

In the use of a separate purifying vessel utilizing vacuum, the beer which is to be treated is first conveyed by means of a pipe v and rose into a suitable vessel V, (Figure 1). This vessel which is in communication with a vacuum producing apparatus such for instance as a pump by means of a pipe v^1 and which is provided with an inlet pipe v^2 for an indifferent gas for instance carbonic acid, has first a vacuum produced in it which is maintained as far as possible during the operation. By this means the volatile ferment constituents which are deleterious to taste and smell and any remaining air contained in the beer are removed therefrom. As soon as the vessel has been sufficiently filled with such beer, the said beer is forced over into the pasteurizing vessel connected with the purifying vessel by means of a pipe D which may be closed by means of a valve, the said forcing over being produced either by means of carbonic acid which is conveyed into the vessel through the inlet pipe v^2 or by means of a pump p. The pasteurizing vessel A is of course first deprived of air and preferably filled with carbonic acid. In order to assist the action of the vacuum, the purifying vessel V may be provided with a suitable stirring apparatus or agitator R. After this vacuum treatment the beer may if desired be either first scrubbed with carbonic acid under pressure in the vacuum or purifying vessel or only in the pasteurizing vessel. The beer is then either directly after the vacuum treatment or after the subsequent scrubbing just mentioned has taken place, heated and cooled in the pasteurizing vessel in the presence of and in contact with carbonic acid as will now be more particularly described and is then filled into the transport vessels or barrels.

If it be desired to effect the mechanical removal of the volatile bye-products or the remaining air from the beer without vacuum, gradually by means of a suitable scrubbing of the beer with an indifferent gas (more particularly carbonic acid), this may be effected in a separate vessel, the beer being then driven over into the pasteurizing vessel as was the case with the vacuum vessel, or the beer may be subjected to treatment in the pasteurizing vessel (heating vessel) itself.

The process may be more particularly described as regards the latter method of working. The pasteurizing boiler or vessel is filled with beer up to about four-fifths of its capacity. The mixture of air and carbonic acid contained above the beer is compressed by means of carbonic acid conveyed therein, and then, after the closing of the vessel, any carbonic acid existing in the same is forced into the beer by means

of a stirring apparatus. For this object the boiler is provided with a discharge pipe capable of being closed and also with a carbonic acid supply pipe capable of being closed. It is also provided with a shaft on which the stirrers or arms are mounted. ~~The~~ *part of the* carbonic acid forced into the beer thus takes the place of the volatile bye-products contained in the beer (air, other gases and volatile compounds) ~~which~~ *and driven out by the said carbonic acid gas, which bye-products then* accumulate in the upper part of the vessel together with such parts of the carbonic acid as again escape from the beer. For the purpose of more rapidly separating the bye-products the beer may be heated to about 30° C. The bye-products accumulated in the upper part of the boiler, in addition to the unabsorbed carbonic acid, may be removed by a blow-off pipe by means of a fresh current of pure carbonic acid. By a frequent repetition of this scrubbing and the forcing-in and letting-off of the carbonic acid at a suitable temperature of about 20—30° C., a thorough removal of the deleterious volatile bye-products and remaining air from the beer may be effected so completely that the heating (pasteurizing) of the beer may then take place.

The following apparatus (shown in Figures 2 and 3) is suitable for this purpose. The heating boiler A is preferably provided with a shaft B running right through and having stirrer arms *b* mounted thereon, by the action of which the heating of the beer is rendered even whilst the carbonic acid admitted or introduced into the heating boiler by means of a pipe K may be thoroughly combined with the beer. The heating of the beer preferably takes place by means of expanded steam which is conveyed to a heating casing or jacket A^1 through a pipe C. In order to increase the heating surface, tubes A^2 are provided in the interior of the boiler which communicate with the heating casing or jacket. Cooling liquids may be admitted through a pipe F to the casing or jacket A^1 and steam may if desired be admitted to the boiler A through another pipe C^1. The beer is admitted into the heating boiler through a pipe capable of being closed by means of a valve D and after treatment may be withdrawn through a valve D^1 and pipe. In order to ascertain the temperature thermometers *e* are employed, and safety valves *d* d^1 are fitted on the casing or jacket and on the heating boiler itself. Inspection windows or peepholes *f* are also provided to enable the interior of the heating boiler to be inspected. On the under part of the heating casing a pipe *g* fitted with a valve is provided for carrying off the water of condensation and in the lower part of the heating boiler A another pipe g^1 for cleaning and discharging purposes is similarly arranged.

A discharge pipe *r* is arranged for carrying off the air expelled from the beer and containing carbonic acid and a pipe *o* for connecting if desired with a vacuum apparatus in case it is preferred to support this repeated scrubbing by the use of vacuum.

The subsidiary apparatus such as filters, collecting vats and the like (not shown in the drawings) which communicate with the heating boiler by means of pipes capable of being shut off need not further be described, but if desired they may like the heating boiler be made to work with vacuum.

As already stated the removal of the undesirable volatile bye-products of the beer and of the remaining air may be effected by the combined use of vacuum and scrubbing. This combined use may be carried out by the vacuum treatment being effected in a separate vessel and the subsequent scrubbing either in the same vessel or in the heating vessel. This combined use of vacuum and scrubbing may however take place in the heating vessel itself. In this case the heating (pasteurizing) of the beer is effected in an hermetically closed vessel and under constant agitation of the beer with carbonic acid until the sterilization is sufficient after which a rapid cooling is effected. All this takes place constantly in a carbonic acid atmosphere and under pressure whereby any re-infection of the beer is avoided and a re-saturation of the beer with carbonic acid is attained.

If it be desired to produce beer rich in carbonic acid this may be attained by introducing an increased quantity of carbonic acid and by more strongly impregnating the beer with it.

Gronwald's Improvements in and relating to Preserving Beer.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

~~1.~~ A process for preserving beer, which consists in removing before sterilising by heating the volatile or gaseous constituents contained in said beer by mechanical means and the use of a vacuum *without increasing the temperature* which constituents deleteriously affect the taste and smell, said operation being assisted in its action by scrubbing the beer with an indifferent gas, such as carbonic acid under pressure, and if desired slightly warming it *for this scrubbing action*, whilst instead of a vacuum a repeated scrubbing with carbonic acid may also take place, the beer thus treated being afterwards heated and cooled in contact with carbonic acid, substantially as hereinbefore described and with the object set forth.

~~2. An apparatus for preserving beer in the manner hereinbefore described, consisting of a vessel (A) provided with stirrers and a casing (A¹) capable of being filled with a heating or cooling mixture and connected by means of suitable pipes with an air pump or other means of producing vacuum, and with a carbonic acid gas supply, substantially as hereinbefore set forth and shown in the accompanying drawings.~~

Dated this 10th day of August 1898.

WM. P. THOMPSON & Co.,
Of 6, Lord Street, Liverpool, Agents for the Applicant.

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